DEPARTMENT OF AGRICULTURE

DAIRY AND COLD STORAGE BRANCH

OTTAWA, CANADA

BULLETINS 51 TO 58—CIRCULARS 22 TO 31

OF THE

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1917 - 1921

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DEPARTMENT OF AGRICULTURE
DAIRY AND COLD STORAGE COMMISSIONER'S BRANCH
OTTAWA - CANADA

THE RATE OF PRECOOLING FRUIT IN DIFFERENT STYLES OF PACKAGES AND AT DIFFERENT TEMPERATURES

BY

EDWIN SMITH, B.S.A.,

AND

J. M. CREELMAN, B.S.A.

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FEBRUARY, 1917

18270—1

LETTER OF TRANSMITTAL.

To the Honourable
The Minister of Agriculture.

SIR,—I beg to submit for your approval a report of some investigations carried on at the Grimsby Precooling and Experimental Fruit Warehouse to determine the rate at which fruit can be cooled in different styles of packages and at different temperatures. The information should be useful to fruit growers and others engaged in the shipping of fruit.

I have the honour to recommend that this report be published as Bulletin No. 51 of the Dairy and Cold Storage Series.

I have the honour to be, sir,

Your obedient servant,

J. A. RUDDICK,
Dairy and Cold Storage Commissioner.

OTTAWA, ONT., February 3, 1917.

18270—1½

RATE OF PRECOOLING FRUIT.

INTRODUCTION.

In establishing precooling plants, there has been need of more information concerning the rate of cooling in the centres of the different packages of various kinds of fruit when exposed to a cooling air of a given temperature. The tests discussed herein were made with this end in view.

There has also been need of reliable information regarding behaviour of summer fruits when precooled quickly in four or five hours' time, using a temperature below freezing to do the work, as compared with the behaviour of fruit cooled slowly over a period of eighteen or twenty-four hours.

In making these tests the given variety and type of package of fruit has commonly been divided into four lots, one-half of which were stored at 40° F., or a refrigerator car temperature, and half at 32° F. One lot in each temperature was cooled rapidly at a temperature lower than 25° F., while the other lot was cooled gradually, using a temperature of 40°, for several hours. In rapid precooling the fruit was removed from the low temperatures as soon as the interior of the package was cooled to a temperature between 32° and 40° F., so that no freezing took place.

In securing the records of the rate of cooling, extension mercurial recording thermometers were used, having the sensitive bulb in the centre of the packages tested.

In studying these records and applying them to commercial conditions, it is well to consider the fact that they were made with the temperature of the air surrounding the package constant or very nearly constant during the entire period of cooling. Under commercial conditions, unless a large reserve of refrigeration is on hand, and is controlled automatically, the temperature of the cooling air is bound to be higher when the fruit is warm at the start of cooling than it will be after cooling has progressed.

RESULTS

In stating results averages will be given showing wastage after a long storage period, so as to make comparisons:—

STRAWBERRIES.

	Low Temperatures used, 20° F. Average Percentage of Waste.	
	Cooled Rapidly.	Cooled Slowly.
Held 6 days at 32° F.	9·0	0·0
Held 6 days at 40° F.	9·0	12·7

No injury was apparent from the rapid cooling and although the averages show the rapidly cooled to be superior, no practical difference could be seen in making inspections.

CHERRIES—SWEET.

	Low Temperatures used, 12° F. and 15° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 14 days at 32° F.	0·0	0·0
Held 14 days at 40° F.	6·93	6·55

With the Napoleon Biggareau variety a slight injury was apparent from using 12° F., so slight as to be negligible. Otherwise, no difference could be seen between the two methods.

CHERRIES—SOUR.

	Low Temperatures used, 17° F. and 20° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 10 days at 32° F.	6·67	5·41
Held 10 days at 40° F.	10·01	12·73

No injury was to be seen from rapid cooling.

RASPBERRIES.

	Low Temperatures used, 20° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 6 days at 32° F.	0·0	0·0
Held 6 days at 40° F.	2·68	1·90

Averages of wastage favour slow cooling. The amount of difference, if any, could be seen in the general appearance of the fruit.

PLUMS.

	Low Temperatures used, 15° F. and 20° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 20 days at 32° F.	2·55	1·96
Held 20 days at 40° F.	6·97	7·36

No injury was apparent from rapid cooling.

PEACHES.

	Low Temperatures used, 15° F. and 20° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 20 days at 32° F.	0·0	0·84
Held 20 days at 40° F.	0·32	1·07

No injury was apparent from rapid cooling.

TOMATOES.

	Low Temperatures used, 15° F. Average Percentage of Waste. Cooled Rapidly.	Cooled Slowly.
Held 20 days at 32° F.	0·0	16·88
Held 20 days at 40° F.	18·57	14·26

Low temperatures are not satisfactory with tomatoes. Tests thus far with tomatoes have not been conclusive in arriving at the best temperatures for precooling or storage. Temperatures slightly below 32° F. may be safely used if precooling is stopped as soon as the tomatoes reach a temperature of 38° F.

TIME REQUIRED FOR PRECOOLING.

In order to show the necessary time required to lower the temperature of the interior of different packages of fruit, the following charts have been prepared from recording thermometer records, the fruit being at different temperatures when placed for cooling and being subjected to different air temperatures while cooling.

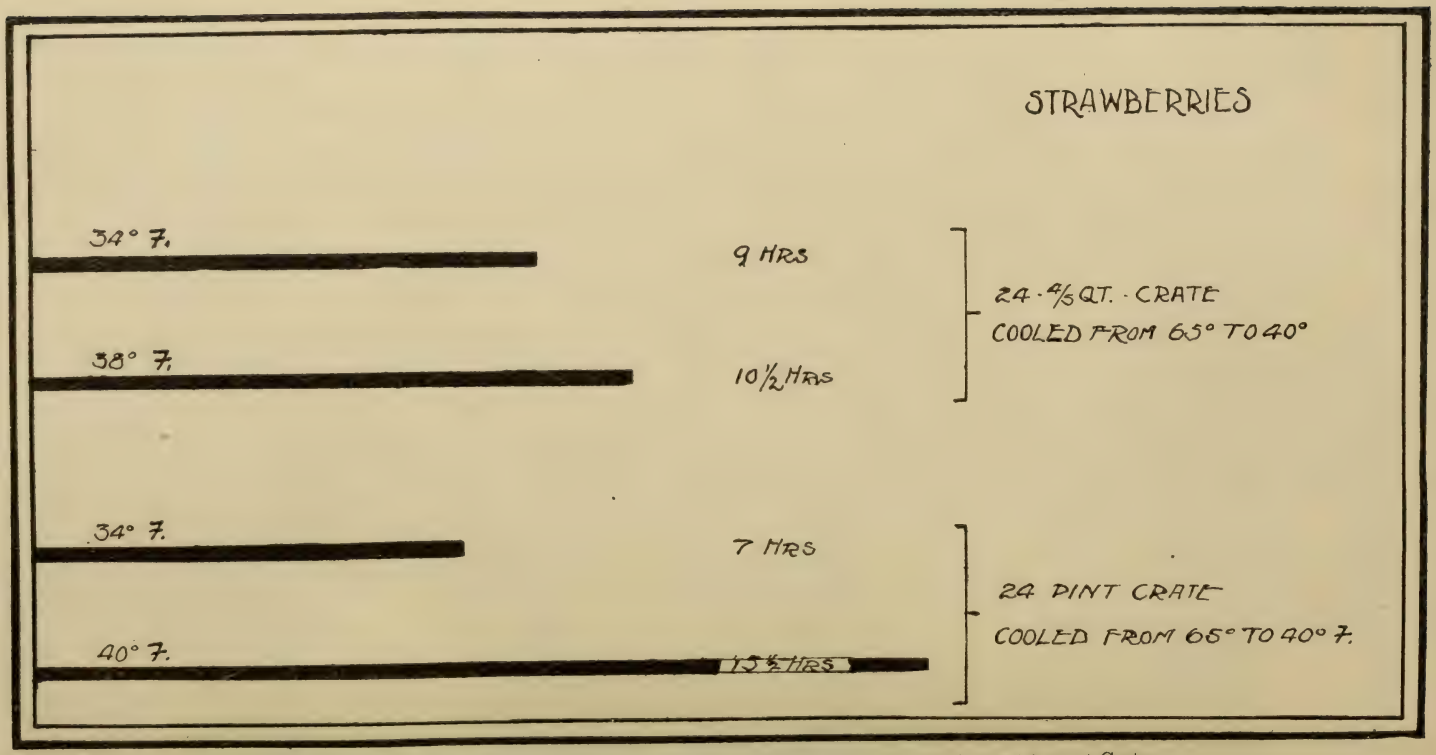

Diagram 1.—Showing length of time required to cool Strawberries in 24 pint and ⅘ quart Crates.

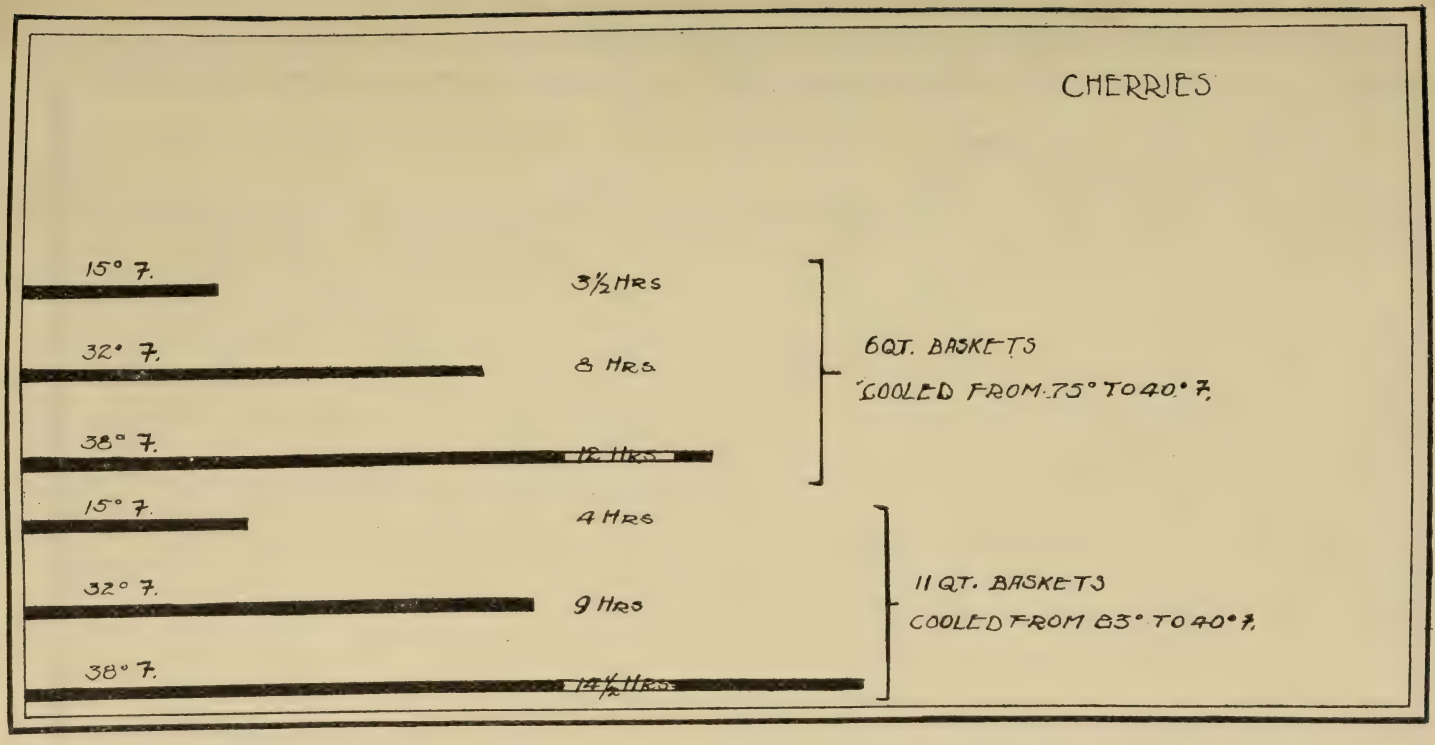

Diagram 2.—Showing length of time required to cool Cherries in 6 quart and 11 quart Baskets.

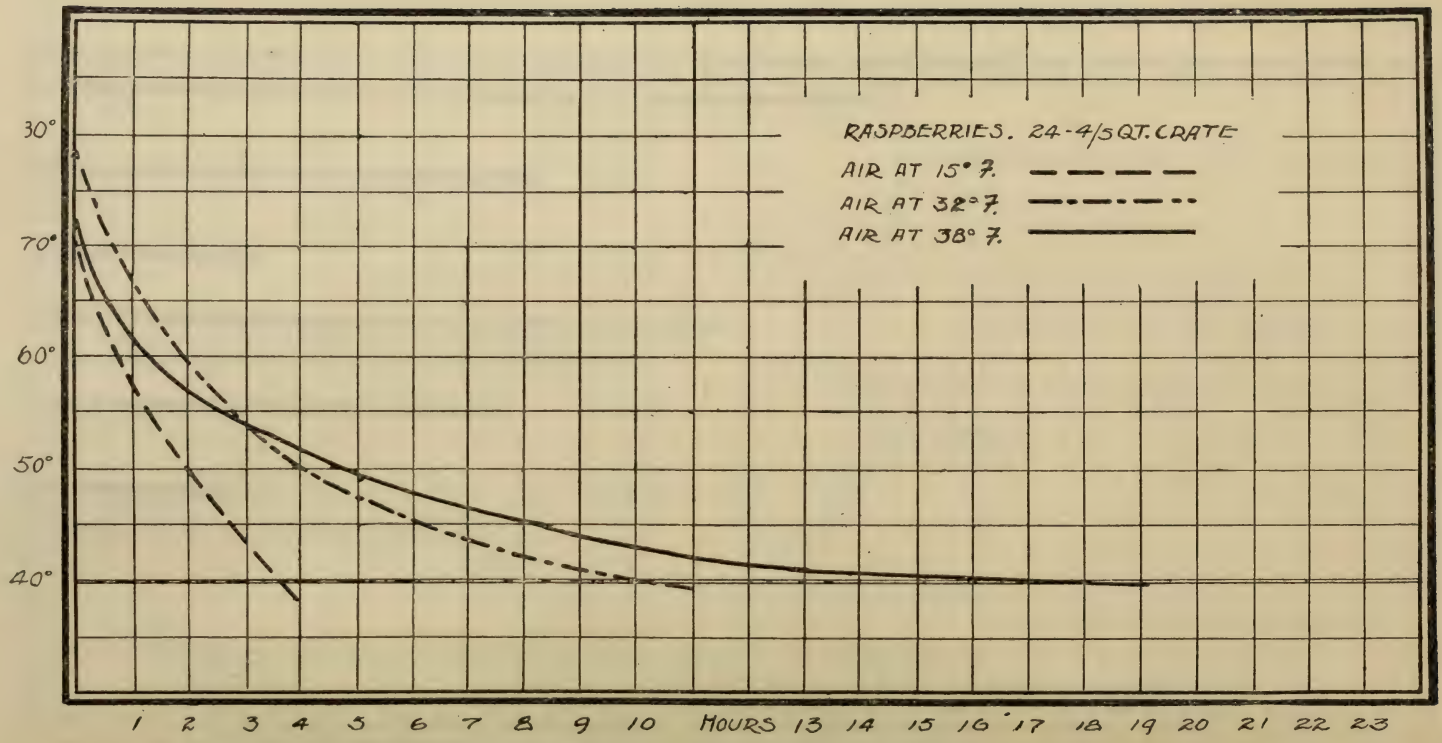

Diagram 3.—Showing rate of cooling of Raspberries in 24⅘ quart Crates.

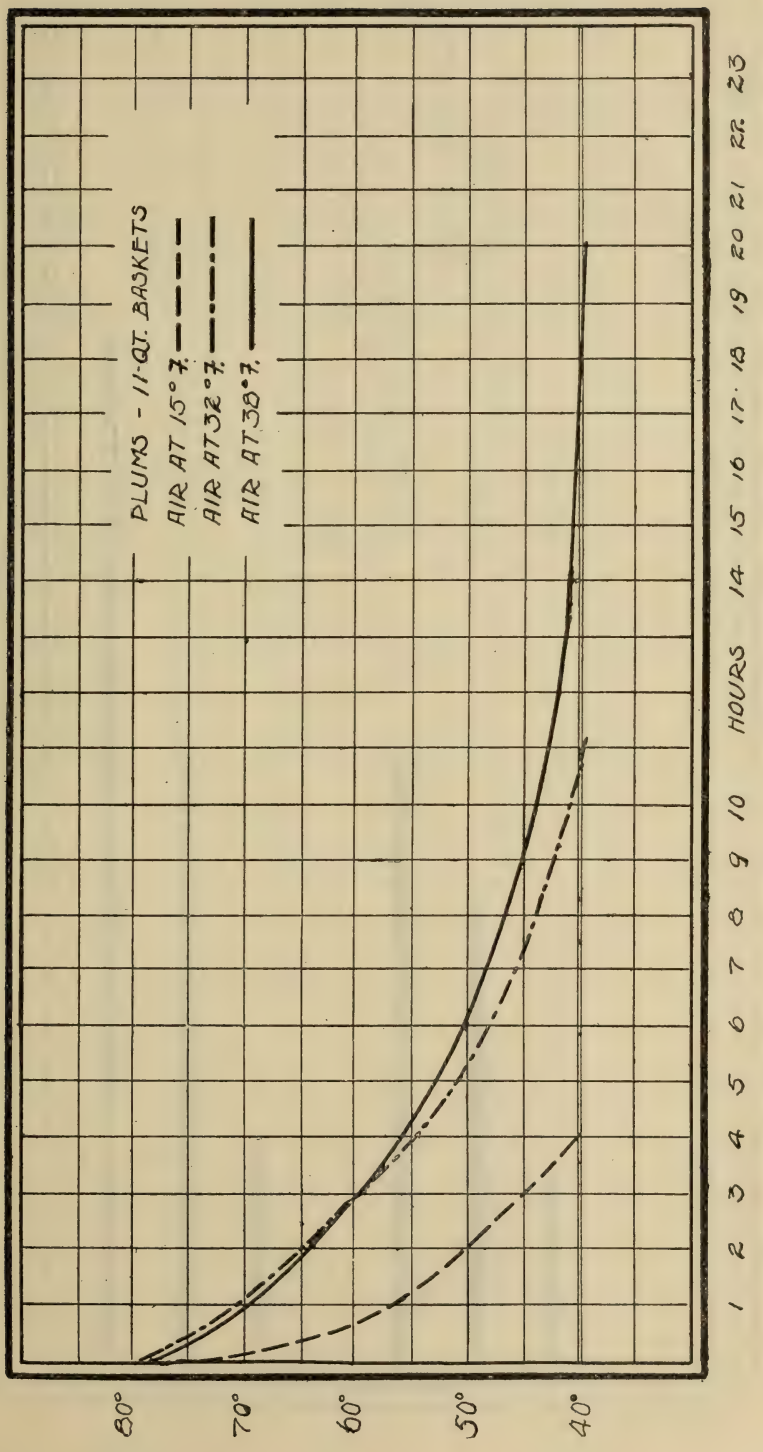

Diagram 4.—Showing rate of cooling of Plums in 11 quart Baskets.

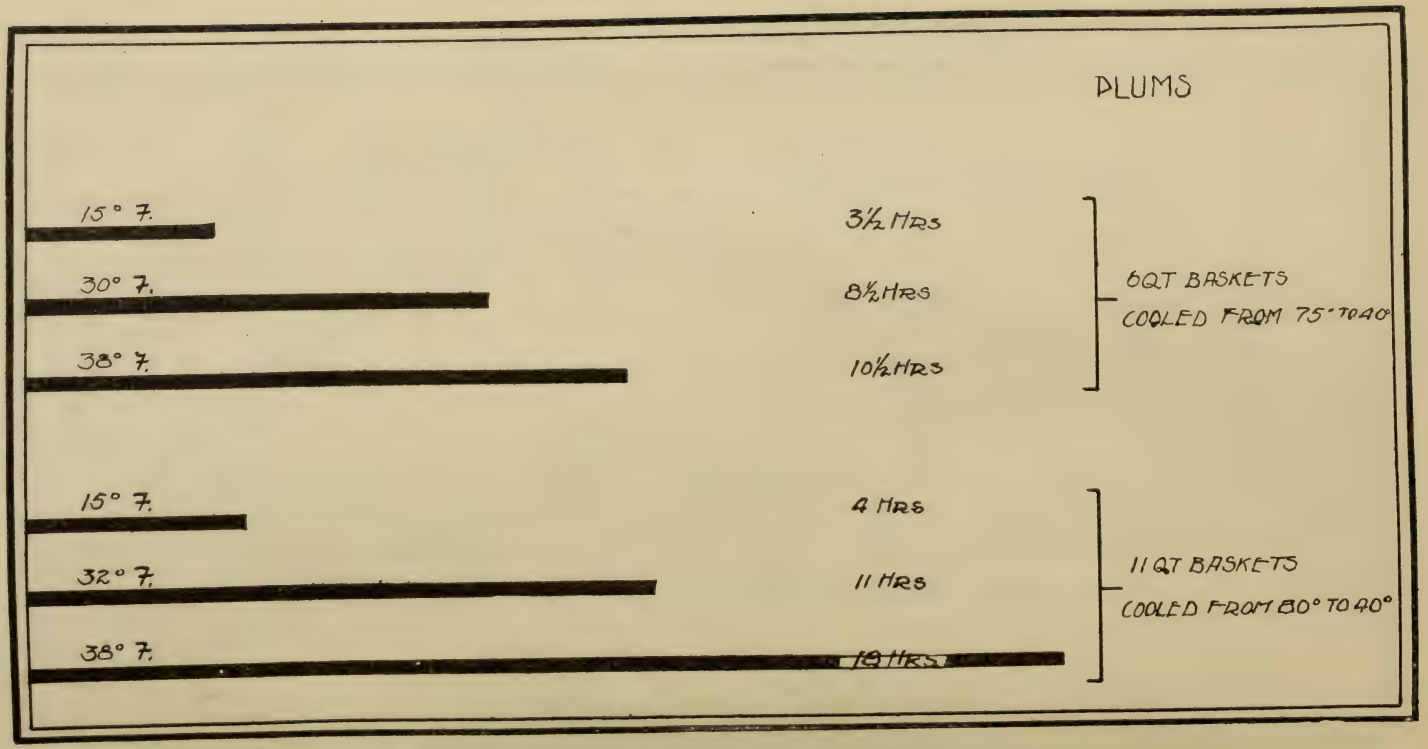

Diagram 5.—Showing length of time required to cool Plums in 6 quart and 11 quart Baskets.

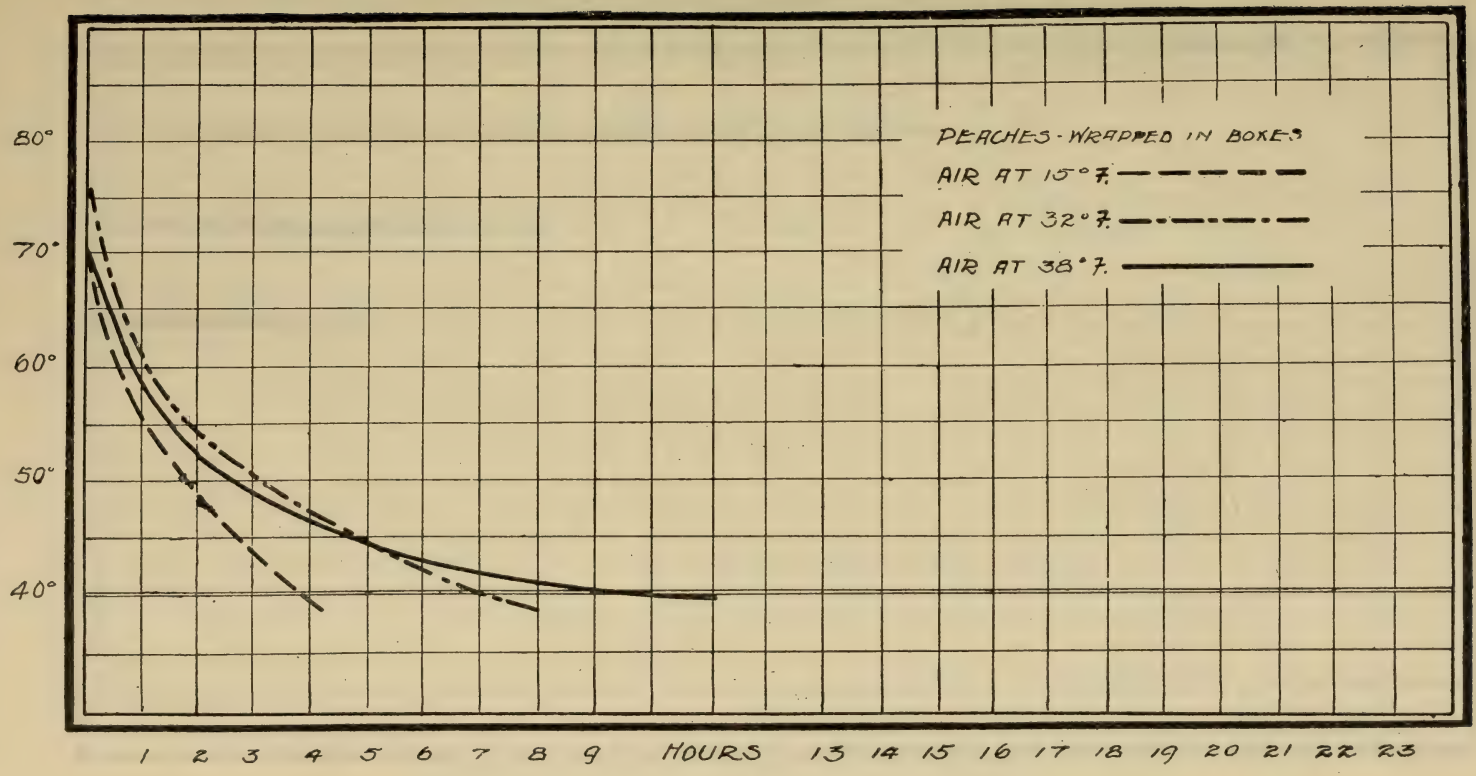

Diagram 6.—Showing rate of cooling of wrapped Peaches in Boxes.

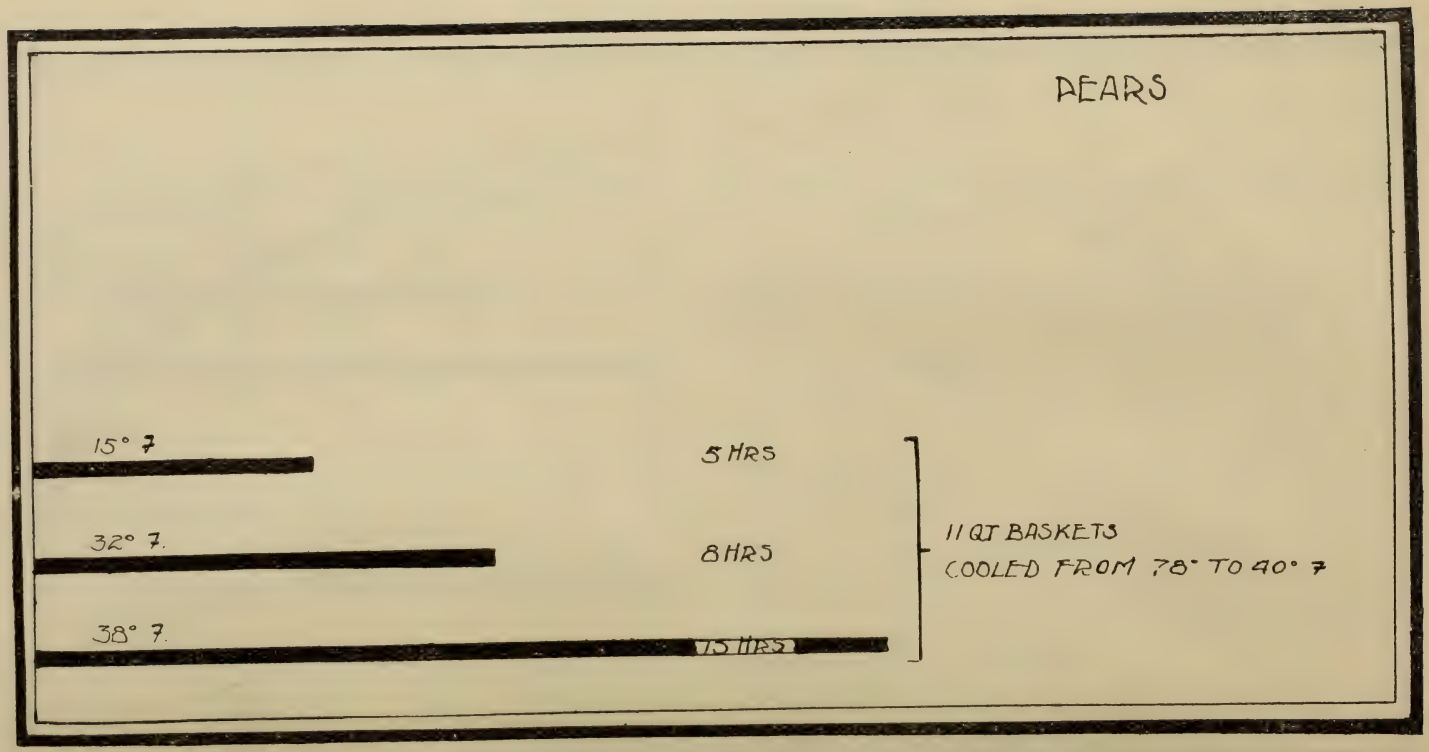

Diagram 7.—Showing length of time required to cool Pears in 11 quart Baskets.

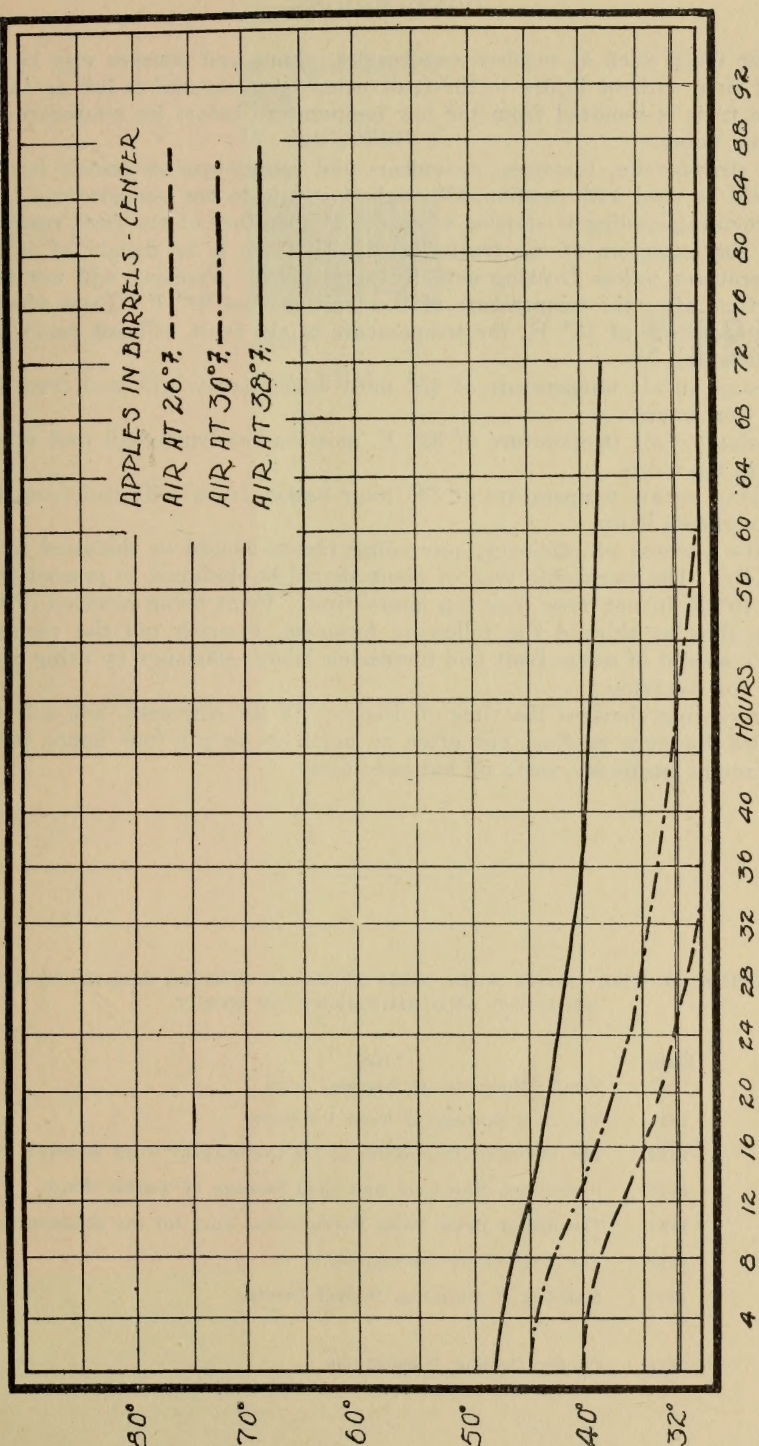

Diagram 8.—Showing rate of cooling of Apples in the centre of the Barrel.

CONCLUSIONS.

Tender fruits such as raspberries, cherries, plums and peaches may be precooled in a short time without injury to the fruit using temperatures as low as 15° F., providing the fruit is removed from the low temperature before its temperature reaches the freezing point.

With strawberries, tomatoes, cucumbers and cantaloupes extremely low temperatures should be used with caution, although it is safe to use temperatures lower than 32° F., providing cooling is stopped when the temperature of the fruit reaches 38° F.

With the exception of the fruits mentioned, there is no danger of injury from low temperatures unless freezing actually takes place. Freezing will not take place for some time after the temperature of the fruit reaches 32° F. Even when using a cooling temperature of 15° F., the temperature of the fruit will not reach this point for several hours.

By using an air temperature of 15° most basket fruits will cool from 75° F. to 40° F. in four hours.

By using an air temperature of 32° F. most basket fruits will cool from 75° F. to 40° F. in ten hours.

By using an air temperature of 38° most basket fruits will cool from 75° F. to 40° F. in eighteen hours.

For the purpose of efficiency, precooling plants should be designed to do their work rapidly. The warehouse type of plant should be designed to precool fruit from 85° F. to 40° F. in not more than ten hours' time. Fruit being received in the afternoon may thus be shipped the following forenoon, clearing out the rooms for the afternoon's receipt of warm fruit and increasing labour efficiency by using men in the afternoon for receiving.

Rapid cooling shortens the time of despatch of the shipment, not only the extra time needed for slow cooling, but often as much as twenty-four hours where long-distance freight trains are made up but once daily.

BULLETINS OF THE DAIRY AND COLD STORAGE SERIES RELATING TO THE STORAGE AND SHIPMENT OF FRUIT.

No.	Date.	Title.
27	1911	Trial Shipments of Peaches, 1910.
44	1915	The Cold Storage of Food Products.
47	1916	The Grimsby Precooling and Experimental Fruit Storage Warehouse.
48	1916	Precooling, Shipment and Cold Storage of Tender Fruit.
50	1917	The use of Brine Tank Refrigerator Cars for the shipment of Fruit.
51	1917	The Rate of Precooling, etc.
52	1917	Methods of Handling Basket Fruits.
Circular.		
15	1916	Cherry Cooling Possibilities.